data storage module **114** can be contained within module enclosure **112** to reduce any shock or vibration therein. More specifically, when hook **248** is positioned to lock lever handle **220** against bezel **200**, lever knob **232** is firmly wedged against pressure plate tab **152** and against the leading edge of lock via **154** to create a vertical and horizontal pressure, respectively, between data storage module **114**, and circuit board **130**.

This pressure created between data storage module **190**, enclosure tabs **152**, and circuit board **130** is directly related to the pliability or thickness of circuit board **130** and pressure plate tab **152**. Consequently, with the help of the mated connectors **166** and **132** and the pressure applied to the stepped guide rail portions **185*d*** by guide tracks **134*h*,** the inventive system reduces, if not prevents, any motion of data storage module **114** in all directions. In particular,

a) Vertical and longitudinal movements of data storage module **114** relative to enclosure **112** are constrained, even with the manufacturing gap as described in the background of the invention. The circuit board or backplane **130** in the longitudinal direction and the pressure plate tabs **152** on enclosure **112** in the vertical direction provide the compliance to the mass of the data storage module **114**. The resulting system **110** works as a vibration/shock isolator. This is possible because the geometry, material, and the location of attachment of pressure plate tabs **152** are designed so that the combined system behaves like a mass-spring system with a hardening spring. A spring is called "hardening" if the incremental force required to produce a given displacement becomes increasingly greater as the spring is deformed. The advantage of using the hardening spring is that it can effectively control the large movement of the module in response to the shock and vibration imparted upon the system.

b) The movement of the module in the horizontal direction is damped by the Coulomb friction damping. When the module is fully inserted in enclosure **112** and lever handle **220** is closed, pressure plate tabs **152** on enclosure **112** develops compressive forces against the lock knob **232** of the lever handle **220**. A force, known as Coulomb friction, is generated in opposing directions of the movement of the module and attenuates the vibrations that were resulted from shock and movement imparted upon the system.

c) Since the horizontal axis of the module is parallel with those of the disk stack spindle and the rotary actuator of a typical modem disk drive, the rotational constraint of the module about this axis is critical for prevention of rotational vibration of the disk drives in a data storage system. When the module is in the fully inserted position, the strategically located pivotal end of the lever is subjected to the compressive forces generated by pressure plate tabs **152** of enclosure **112** and the movement of data storage module **114** in the vertical direction is compliantly constrained without a gap. This compliance makes the boundary condition of the front end of the module similar to that of the rear end, therefore making the module less responsive to either self-generated or externally applied rotational vibration excitations.

d) Rotational movements of data storage module **114** relative to enclosure **112** about its vertical and longitudinal axes are damped through the friction developed between pressure plate tabs **152** on enclosure **112**, lock knob **232** of lever handle **220**, leading edge of lock via **154** and bay slot. Damping rotational vibrations about these axes will reduce the risk of performance degradation due to the gyroscopic effect of the rotational vibrations imparted upon the high rotational speed disk drives.

Consequently, these points of pressure allow the data storage module of the present invention to reduce any vibration or motion within the manufacturing gap created by an internal or external force associate to the system in all translational directions.

The smooth motion used to insert data storage module **114** is transparent with the process for removing the same. In particular, FIG. **8D** illustrates how the user can remove data storage module **114** by first positioning their fingers **160** between bezel lip **208** and lever latch **240**. With a small smooth pressure against latch **240**, spring **246** (see FIG. **7**) will compress to allow latch **240** to rotate counter-clockwise and thereby release hook **248** from bezel portion **265**. At this stage of the process, the user will allow the pressure created by circuit board **130** to push data storage module slightly out of module enclosure **114** while they begin to lift lever **220** in an upward or extended rotation.

The rotation of lever handle **220** forces the leading edge of lock knob **232** against the leading edge of lock via **154** of enclosure **112** to slide data storage module **114** outwardly from its bay slot **128*h*** and disengage connectors **132**, **166** within enclosure **112**. Once lever **220** has reached an extended position as illustrated in FIG. **8B**, the user will position their hand around lever **220** to obtain a firm grip for removal as used for insertion. As described earlier, this firm grip will allow the leverage the user will need to prevent any gyroscopic motion that may occur during a hot swap and/or any translational motion created by the weight of the data storage module **114** once it is removed from module enclosure **112** as illustrated in FIG. **8A**.

The above process allows a data storage module **114** to be quickly and easily electrically connected to circuit board **130** of the module enclosure **112**. In turn, the process for doing the same requires a relatively small continuous force to provide a smooth locking and unlocking motion so that no jolting motions or excessive pressure has to be used that might otherwise destroy or damage the disk drive memory or circuit board. Once latched, data storage module **114** is held tightly in place to provide a hard mount within module enclosure **112**. This hard mounting greatly attenuates the rotational vibrations created by the spinning platters and helps to prevent rotational vibration problems between the individual platters.

In summary, the present inventive modular data storage system provides a data storage module that can interact with an enclosure to create multiple pressure points within the system such that the negative effects of manufacturing gaps for a conventional system can be reduced, if not eliminated. In addition, the present invention provides a reliable, cost efficient and effective way to reduce translational motion within a conventional data storage system.

What is claimed is:

1. A data storage system, comprising:

an enclosure comprises a frontal opening, a compliant backplane, a plurality of bay slots and associated vias, and a pressure plate, said backplane including a plurality of first electrical connectors, said bay slots extend from said frontal opening to said first electrical connectors, said pressure plate attaches adjacent to said frontal opening and above said plurality of bay slots and vias;

at least one data storage module including a data storage drive, a locking mechanism, and a drive tray, said data storage drive having a second electrical connector sized and configured to mate with one of said plurality of first electrical connectors and a front plate laterally spaced

from said second electrical connector; said drive tray containing said data storage device and including first and second guide rails being shaped to slidably mount within at least one of said plurality of bay slots; and said locking mechanism including a latch and a lever handle, said lever handle being coupled at one end to said front plate and the other end being couple to said latch; and

wherein, said lever handle pivotally moves to lock said at least one data storage module within one of said plurality of bay slots by creating a stabilizing pressure between the data storage module and the enclosure.

2. The apparatus of claim **1**, wherein said lever handle further including a spring mechanism coupled between said drive tray and lever handle to allow said lever handle to provide a resisting pressure when moving said lever handle.

3. The apparatus of claim **1**, wherein said latch pivotally connects to said lever handle.

4. The apparatus of claim **1**, wherein said latch further includes a spring mechanism mounted between said lever handle and said latch, said spring mechanism provides a pressure when moving said pivotal latch.

5. The apparatus of claim **1**, wherein said latch further includes a pivotal hook for locking said data storage module within said bay slot against an adjacent portion of said drive tray.

6. The apparatus of claim **1**, wherein said first and second guide rails further include a stepped surface that is thinner at an end adjacent said second electrical connector than the end adjacent said locking mechanism.

7. The apparatus of claim **6** wherein said stepped surface of said first and second guide rails resides on only one side of said first and second guide rails .

8. The apparatus of claim **1**, wherein said lever handle further includes a lock knob attached to said pivotal end and capable of fitting through at least one of said vias to apply a pressure against a reciprocating portion of said pressure plate, enclosure and backplane.

9. The apparatus of claim **1**, wherein the outer surface of said lever handle and drive tray further include a plurality of corresponding venting holes to assist with the flow of air between the drive tray, enclosure and area outside the system.

10. The apparatus of claim **1**, wherein said locking mechanism further includes a bezel connected between said front plate and said lever handle.

11. The apparatus of claim **1**, wherein said stabilizing pressure can be translated into a vertical, horizontal and lateral plane.

12. The apparatus of claim **1**, wherein said pressure plate is made from a spring alloy selected from the group including stainless steel and carbon steel.

13. The apparatus of claim **1**, wherein said guide rails and lever arm are made from a polymeric material.

14. A process for securing a data storage module within a reciprocating enclosure, comprising:

gripping a pivotal lever handle attached to a front end of the data storage module, said handle being positioned in an extended position such that the users fingers rest across and between the lever handle and the front end of the data storage module;

aligning guide rails of the data storage module with a set of guide tracks within the enclosure;

slidably inserting said guide rails between said set of guide tracks until a knob of the handle contacts a lock via of the enclosure; and

rotating the pivotal lever handle until said locking knob fills said locking via to apply a stabilizing pressure between a pressure plate, said locking via, and the enclosure.

15. The assembly of claim **14**, further including applying pressure to a pivotal latch of said pivotal lever handle to unlock said data storage module from said enclosure.

16. The apparatus of claim **14**, wherein said stabilizing pressure can be translated into a vertical, horizontal and lateral plane.

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